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[Amendments: There are no amendments attached to this patent although statement of (correction present) is shown in the column of [ABSTRACT]. Translator's note]

[Note: All names, addresses, company names, and brand names are translated in the most common manner, Japanese language does not have singular or plural words unless otherwise specified with numeral prefix or general form of plurality suffix. Translator's note]

(54) [TITLE OF THE INVENTION]

MANUFACTURING METHOD OF CELL BARRIERS OF PLASMA DISPLAY
PANEL [Plasma display panel no cell shoheki seizo hoho]

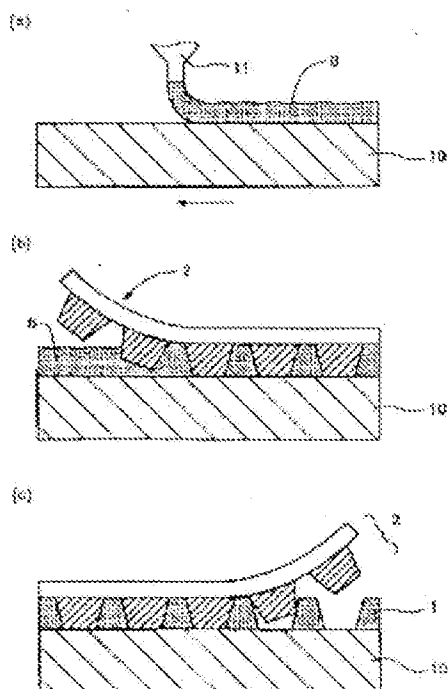
(57) [ABSTRACT] (Correction present)

[PURPOSE]

It manufactures cell barriers of any optional shapes with good precision, convenience, promptness, and stability.

[CONSTITUTION]

An electrolytic dissociative [note: the term dissociative is omitted hereafter to express electrolytic dissociative radiation curing resin, translator's note] radiation curing resin is packed at a plate intaglio part of a roll intaglio having a plate surface that corresponds to the shape of cell barrier part (1), and at the same time, a film backing [note: original document often refers to term backing and substrate, and although Japanese characters are different for these two terms, printing dictionary states the same term as substrate; and in order to distinguish this as Japanese characters are different, translator opted to use backing as in the case of film backing and substrate as in the case of glass substrate all through this translation, translator's note] is contacted with the roll intaglio, and while they are in contact, electrolytic radiation ray is irradiated on the electrolytic radiation curing resin to cure this to form a electrolytic radiation curing resin layer; and then, electrolytic radiation curing resin layer is peeled off along with a film substrate from the roll intaglio to give a formed sheet having sheet concave part showing a concave/convex shape that is reversal to that of the cell barrier part. A glass paste (8) is coated on a surface of glass substrate (10). After press contacting a shaping sheet (2) onto thus coated glass substrate, the shaping sheet is peeled off to form the glass paste into the shape of cell barriers. Thus formed glass paste is burnt through a burning process.



[CLAIMS]

[CLAIM ITEM 1]

According to a method to manufacture cell barriers for a plasma display panel having an arrangement of mutually opposing front side plate and a back side plate that is equipped with cell barriers that constitute plural number of spaces for purpose of electric discharging in a parallel manner, the manufacturing method of cell barriers of plasma display panel is characterized by the fact that consists of following (A) ~ (D):

- (A) A manufacturing process of a shaping sheet by using a roll intaglio that has a plate intaglio part corresponding to a shapes of cell barrier part ; and by packing an electrolytic radiation curing resin in at the least plate intaglio part of said roll intaglio, and at the same time, by press contacting a film backing with the roll intaglio, and while they are in contact, by irradiating electrolytic radiation ray to cure said electrolytic radiation curing resin that is lying between the film backing and the roll intaglio to form an electrolytic radiation curing resin layer, and then, by peeling off electrolytic radiation curing resin layer that is anchored to the film backing along with film backing from the plate intaglio part to provide a shaping sheet having the sheet concave part that is of concave/convex shape reversal to that of the cell barrier part.
- (B) A coating process to coat a glass paste on a surface of glass substrate.
- (C) A molding process that forms glass paste that is on the glass substrate surface in a shape of cell barrier after press contacting the shaping sheet onto glass substrate that is coated with a glass paste.
- (D) A burn process that burns thus formed glass paste.

[DETAILED EXPLANATION OF THE INVENTION]

[0001]

[FIELDS OF INDUSTRIAL APPLICATION]

This invention relates to the manufacturing method of cell barriers of a plasma display panel (this will be hereafter abbreviated as PDP) comprising plural numbers of electrical discharging spaces formed by cell barriers.

[0002]

[PRIOR ART]

Regarding conventional manufacturing method of cell barriers of PDP, a method that first patterns a glass paste on a glass substrate by a screen printing method, and burns this has been utilized; and in order to gain necessary height of the cell barriers, practice has been to repeat printing and drying for, tens and several times as an example for purpose of lamination, and then, burning this. In addition, in order to improve the precision of that barrier shape, a method to arrange a new oil type polymer layer [note: although original document states new oil type, it may be a misprint of lipophilic type, translator's note] at the portion where cell barriers are formed on the glass substrate has been also proposed (make reference to the Japanese patent application, Tokkai Hei 5 [1993]-166460 publication)

[0003]

[SUBJECTS SOLVED BY THIS INVENTION]

However, according to above-explained conventional manufacturing method, although manufacturing device not being of the special type to ease such processes, it has been known to present such problems as a tendency to require many number of processes as well as shape of the cell barrier given by screen printing may collapse prior to burning, and above all, with increase in repeat printing frequencies, tendency toward deterioration on the shape precision occurs to lack preciseness.

[0004]

This invention's purpose thereupon is to solve the defects of prior art explained above, and to offer a new manufacturing method that is capable of manufacturing cell barriers with good precision in simple, prompt, and stable manner.

[0005]

[MEANS USED TO SOLVE THE SUBJECTS]

This invention's manufacturing method of cell barriers of plasma display panel that attains above-explained purpose constitutes of following (A) ~ (D) as manufacturing method of cell barriers of plasma display panel comprising a front side sheet and back side sheet equipped with cell barriers to construct plural number of discharging spaces:

- (A) A manufacturing process of a shaping sheet by using a roll intaglio that has a plate intaglio part corresponding to a shape of cell barrier part; and by packing an electrolytic radiation curing resin in at the least plate intaglio part of said roll intaglio, and at the same time, by press contacting a film backing with the roll intaglio and while they are in contact, by irradiating electrolytic radiation ray to cure said electrolytic radiation curing resin that is lying between the film backing and the roll intaglio to form an electrolytic radiation curing resin layer, and then, by peeling off electrolytic radiation curing resin layer that is anchored to the film backing along with film backing from the plate intaglio part to provide a shaping sheet having the sheet concave part that is of concave/convex shape reversal to that of the cell barrier part.
- (B) A coating process to coat a glass paste on a surface of glass substrate.
- (C) A molding process that forms glass paste that is on the glass substrate surface in shape of cell barriers after press contacting the shaping sheet onto glass substrate that is coated with a glass paste.
- (D) A burn process that burns thus formed glass paste.

[0006]

This invention's manufacturing method of cell barriers of plasma display panel is explained in details below with reference to attached Figures.

[0007]

This invention's manufacturing method firstly manufactures a shaping sheet having concave/convex shape that is reversal to the shape of PDP cell barrier part. The shaping sheet has an electrolytic radiation curing resin layer forming sheet concave part on a film backing; and this concave part of the sheet works as a mold that provides a reversal shape to that of PDP cell barrier part.

[0008]

Figure 3 illustrates a schematic view that is one example of manufacturing device of this shaping sheet. The roll intaglio (4) has plate intaglio part (41) with a shape that corresponds to cell barrier part comprising multiple numbers of cell barriers; and it rotates in the arrow-marking direction. The film backing (21) is fed there through appropriate transport means and it is press contacted to the roll intaglio with a press roll (51); and is transported in a synchronous manner while remaining in a state of contacting with the roll intaglio, and it is peeled off from the roll intaglio by a release roll (52), and is further transported. Furthermore, both press roll and release roll are made capable of clearance adjustment and the like with the roll intaglio.

[0009]

To such roll intaglio (4) and film backing (21), electrolytic radiation curing resin (3) is supplied by an appropriate means to pack at the least plate intaglio part of the roll intaglio. According to this Figure, electrolytic radiation curing resin is supplied to the roll intaglio by a coating device (6) from lower part of the roll intaglio. Then, film backing is made to come in contact with the roll intaglio and while sandwiching electrolytic radiation curing resin that is on the film backing and roll intaglio with the film backing and roll intaglio, electrolytic radiation ray is irradiated by using an electrolytic radiation ray irradiation device (7) from the film backing side to cure electrolytic radiation curing resin that lies between film backing and roll intaglio. The electrolytic radiation curing resin becomes electrolytic radiation curing resin layer (22) in a state that is anchored to the film backing through said curing. Then, when film backing is peeled off from the roll intaglio by a release roll, the electrolytic radiation curing resin layer is peeled off along with film backing; and electrolytic radiation curing resin layer forms the shape of portions (discharging space) besides cell barrier part to provide a shaping sheet (2) of which sheet concave part (23) that is formed by said electrolytic radiation curing resin layer forms the shape of cell barrier part.

[0010]

At this time, relationship of cell barrier shape that is subjected, sheet concave part of the shaping sheet, and shape of plate intaglio of the roll intaglio is explained. According to the Figures 2, (a) illustrates roll intaglio (4) and its plate intaglio part (41); and (b) illustrates shaping sheet (2) that is given from the roll intaglio of (a) and its sheet concave part (23); and (c) illustrates cell barrier (1) that is given by the shaping sheet of (b). In addition, roll intaglio has plate intaglio part that corresponds with the shape of cell barrier part. That is to say, when it is thought the plate intaglio part (41) of the roll intaglio (4) to be a concave portion and forms concave space in an intuitive sense, plate intaglio part shows identical shape with the portion (discharging space) other than cell barrier part; and when it is stated conversely, the portion (convex part) other than plate intaglio part shows the identical shape as that of cell barrier part. On the one hand, concave space of sheet concave part (23) takes identical shape as that of cell barrier part on the shaping sheet (2). Furthermore, although it is possible to prepare a molding sheet from a flat intaglio in a sheet form, Figure 2 (a) illustrated plate surface of roll intaglio to be of a flat plane for purpose of convenience of explanation.

[0011]

Regarding above-explained film backing (2) [note: although original document states (2), may be a misprint of (21), translator's note], films showing flexibility and electrolytic radiation ray transmissivity may be used. For instance, films made of resins including polyester such as polyethylene terephthalate, or polyethylene naphthalate and the like, polyethylene, polypropylene, polyvinyl chloride, polyvinylidene chloride, polycarbonate, polyamide, polyimide, polystyrene, ethylene-ethylene acetate copolymer, or polyvinyl alcohol and the like may be mentioned. Among these examples, polyethylene terephthalate film is considered as particularly favorable from the standpoint of consideration over processing aptitude, strength, or cost and the like.

[0012]

Furthermore, supply and packing of electrolytic radiation curing resin may be conducted through direct feed by a roll coating method to the roll intaglio as illustrated in the Figure 3; and it may be also supplied directly to the roll intaglio from a die such as T-die, or prior to when film backing comes in contact with the roll intaglio, it may be pre-coated and formed on said film backing through a roll coating method and the like.

[0013]

Furthermore, as electrolytic radiation curing resin that is used in this invention, polymer, prepolymer, or monomer that initiate crosslinking polymerization reaction through electrolytic radiation ray and become solidified may be used. More specifically, radical polymerization group (at this time, (meth)acryloyl indicates acryloyl or methacryloyl hereafter) comprising compounds having (meth)acryloyl group such as (meth)acryl amide, (meth)acrylonitrile, (meth)acrylic acid, or ester (meth)acrylate and the like; cation polymer group comprising combination of epoxy, cyclic ether, cyclic acetal, lactone, vinyl monomer, cyclic siloxane and aryl diazonium salt, diaryl iodonium salt; compounds having thiol group, for instance, polyene/thiol group comprising trimethylol propane trithioglycolate, trimethylol propane trithio propionate, pentaerithritol tetrathioglycol and polyene compound may be used.

[0014]

As monofunctional monomers of (meth)acrylate compound of radical polymerization group, for instance, methyl (meth)acrylate, ethyl (meth)acrylate, butyl (meth)acrylate, methoxy ethyl (meth)acrylate, methoxy butyl (meth)acrylate, butoxy ethyl (meth)acrylate, 2-ethyl hexyl (meth)acrylate, N,N-dimethyl amino methyl (meth)acrylate, N,N-dimethyl amino ethyl (meth)acrylate, N,N-diethyl amino ethyl (meth)acrylate, N,N-diethyl amino propyl (meth)acrylate, N,N-dibenzyl amino ethyl (meth)acrylate, lauryl (meth)acrylate, isophonyl [transliteration] (meth)acrylate, ethyl Carbitol (meth)acrylate, phenoxy ethyl (meth)acrylate, phenoxy polyethylene glycol (meth)acrylate, tetrahydroxy furfuryl (meth)acrylate, methoxy tripropylene glycol (meth)acrylate, 2-(meth)acryloyloxy ethyl-2-hydroxy propyl phthalate, or 2-(meth)acryloyloxy propyl hydrogen phthalate and the like may be mentioned.

[0015]

In addition, as polyfunctional monomers of radical polymerization group, for instance, ethylene glycol di(meth)acrylate, diethylene glycol di(meth)acrylate, triethylene glycol di(meth)acrylate, propylene glycol di(meth)acrylate, dipropylene glycol di(meth)acrylate, neopentyl glycol di(meth)acrylate, 1,6-hexyl diol di(meth)acrylate, 1,9-nonane diol di(meth)acrylate, tetraethylene glycol di(meth)acrylate, tripropylene glycol di(meth)acrylate, bisphenol A-di(meth)acrylate, trimethylol propane tri (meth)acrylate, trimethylol propane ethylene oxide tri(meth)acrylate, pentaerithritol tri(meth)acrylate, penta erithritol tetra(meth)acrylate, dipenta erithritol penta (meth)acrylate, dipenta erithritol hexa(meth)acrylate, glycerol polyethylene oxide tri(meth)acrylate, or tris (meth)acryloyloxy ethyl phosphate and the like may be mentioned.

[0016]

Furthermore, as prepolymers of radical polymerization group, for instance, (meth)acrylates such as alkyd (meth)acrylate, urethane (meth)acrylate, epoxy (meth)acrylate, polyester (meth)acrylate, polybutadiene (meth)acrylate and unsaturated polyester and the like may be mentioned.

[0017]

Among these compounds including (meth)acryloyl group, compounds that include acryloyl group in particular, that is to say, acrylate shows faster polymerization reaction speed. And therefore, when production speed of coating and forming electrolytic radiation curing resin layer is placed with more importance, acrylate is more preferable than methacrylate.

[0018]

In addition, as electrolytic radiation curing resin of radical polymerization group, one type or mixture of more than two types of above-explained compounds may be used as needed.

[0019]

At this time, as Photopolymerization initiators in the case of curing by UV rays, 0.1 ~ 10 parts by weight of one type or more than two types of benzoin, benzoin methyl ether, acetophenone, benzophenone, Michler's ketone, diphenyl sulfide, dibenzyl disulfide, diethyl oxide, triphenyl biimidazole, or isopropyl-N,N-dimethyl amino benzoate and the like based on 100 parts by weight of said electrolytic radiation curing resin.

[0020]

At this time, as solvents that dissolve said electrolytic radiation curing resin and adjusts its viscosity to provide coating aptitude and are included in the composition including said electrolytic radiation curing resin, one type or more than two types of optional mixture of esters such as ethyl acetate, butyl acetate, or Cellosolve acetate and the like, ketones such as acetone, methyl ethyl ketone, or ethyl isobutyl ketone and the like, and alcohols such as methyl alcohol, ethyl alcohol, or isopropyl alcohol and the like.

[0021]

As electrolytic radiation ray, visible beams, UV rays, X-rays, or electromagnetic wave such as electron beams and the like, or nuclear rays may be used. UV rays or electron beams are mainly used for practical application. As UV ray sources, light sources such as carbon black, black light, or metal halide lamp and the like may be used.

[0022]

As electron beam sources, various electron beam accelerators of Cockcroft-Walton type, van de Graaf type, resonance transformer type, insulation core transformer type, or linear type, dynamitron type, or high frequency type may be used to irradiate electrons showing 100 ~ 1000 keV, or more preferably, 100 ~ 300 keV energy. Regarding irradiation dosage, it is generally 0.5 ~ 30 Mrad.

[0023]

Furthermore, as an irradiation method of electrolytic radiation ray, it is all right to first irradiate UV rays to cure electrolytic radiation curing resin layer to dry its surface at the least to such level that can be touched with fingers or more, and then, electron beams may be used to totally cure this.

[0024]

As shaping sheet given in above-explained manner is used as a shaping mold, and this is pressed against glass paste that is prepared by dispersing glass frit formed of PbO and the like, heat-resistant pigment and the like in an organic vehicle and is coated on a glass substrate through appropriate means to mold to prescribed cell barrier shape.

[0025]

Regarding the coating means during coating process that coats glass paste on the glass substrate, extrusion method such as T-die, or method that utilizes gap by blade (make reference to the Figure 11) and the like may be used appropriately. According to the Figure 3 (a), glass paste is coated through a T-die.

[0026]

Then, as a molding process of glass paste, shaping sheet (2) is pressed against glass paste as illustrated in the Figure 3 (b) while vehicle solvent of the glass paste remains as not dry to pack the glass paste in the sheet concave part of the shaping sheet, and at the same time, convex plane of electrolytic radiation curing resin layer of the shaping sheet is press contacted till that comes in contact with the glass substrate. Then, as illustrated in the Figure 3 (c), when shaping sheet is peeled off before glass paste that is packed in the sheet concave part dries, glass paste remains in a molded state at the glass substrate side. Figure 4 illustrates shaping sheet (2) and cell barrier (1) on the glass substrate (10) molded with the shaping sheet (2). Furthermore, as inner plane of the sheet concave part is appropriately adjusted so the material of electrolytic radiation curing resin layer and the like would show less wetting against glass paste than that of the glass substrate surface, glass paste would remain at the glass substrate side as the time of peel off.

[0027]

The glass paste that can become prescribed cell barrier shape with prescribed height can be molded on a glass substrate through one time operation; and when this is burned at prescribed burn conditions, cell barriers with subjected shape can be given. In addition, back side plate on which cell barriers are formed and front side plate are sealed to give PDP showing cell barrier structure as illustrated in the Figure 5.

[0028]

One of the characteristics of this invention is possible forming of cell barriers with prescribed height and prescribed shape by one time patterning treatment on the glass substrate; and because trapezoidal cross sectional shape as illustrated in the Figure 4 can reduce the area of cell barrier front side at the portion that is bonded with front side plate, it shows a beneficial point of possible forming of a broad pixel area to improve brightness through improved aperture of PDP.

[0029]

Regarding the shape of cell barriers, Figure 4 illustrates a trapezoidal shape in which mutually opposing cell barriers that form cells are separated; and besides this, various shapes of cell barrier (1) and shape of shaping sheet (2) that is used to form these are illustrated as examples in Figure 6 ~ Figure 8. Figure 6 illustrates a triangular shape in which mutually opposing cell barriers are separated; and Figure 7 illustrates a curved line shape that forms convex shape at the front side plate that is separated; and for instance, it is of a half-elliptic shape. Furthermore, cross sections of these cell barriers, for instance, show vertical cross sectional shape of cell barrier that forms one side of the cell of which 4 sides are surrounded; and flat plane shape of cells does not matter.

[0030]

[ACTIONS]

According to the manufacturing method of this invention, shaping sheet that becomes a shaping mold of glass paste can be given at high precision through electrolytic radiation curing resin that is packed at the roll intaglio. In addition, by pressing this shaping sheet against glass paste that is coated on a glass substrate in almost uniform manner, glass paste is packed in the sheet concave part, and then, when shaping sheet is peeled off, with difference in wetting between sheet concave part of the glass paste and glass substrate, glass paste is molded and remains at the glass substrate side. Because shape of glass paste formed on the glass substrate is made to correspond with the shape of sheet concave part, by making the shape of sheet concave part as the shape of subjected cell barrier part, glass paste showing subjected shape can be formed on the glass substrate by one time treatment on the glass substrate. And, subjected cell barriers can be given by burning.

[0031]

[EXAMPLES]

This invention is further explained in details below with specific examples.

[0032]

<<EXAMPLE 1 >>

MANUFACTURING OF SHAPING SHEET

On one plane of polyethylene terephthalate film with 25 μm thickness (T-60 made by Toray K.K.) that is used as a film backing, shaping sheet manufacturing device that is illustrated in the Figure 3, roll intaglio of which plate intaglio part has concave space of regular quadrangle cone shape and electrolytic radiation curing resin composition explained below were used to give a shaping sheet of which female mold of cell barrier part showing reverse concave/convex shape to that of cell barriers that is arranged on one plane of the film backing under the conditions explained below.

[0033]

ROLL INTAGLIO

Cross sectional shape of plate surface: trapezoidal shape of which vertical cross section is separated [male reference to the Figure 9], and horizontal cross section is of a stripe shape,

Cell pitch P: 200 μm

Cell groove width W: top bottom 180 μm , lower bottom 150 μm

Cell depth D : 150 μm

[0034]

ELECTROLYTIC RADIATION CURING RESIN COMPOSITION

Penta erithritol triacrylate 90 parts by weight

Urethane acrylate oligomer 10 parts by weight

[0035]

IRRADIATION CONDITION

Electron beams of 10 Mrad were irradiated by using a curtain beam type electron beam irradiation device.

[0036]

Then, glass paste prepared by dispersing low melt point glass frit, heat-resistant pigment and the like in an organic binder was coated on a glass substrate at 100 μm film thickness by a blade coating method, and then, shaping sheet prepared as explained above was press contacted on the glass paste coated on the glass substrate, and then, shaping sheet was peeled off from the glass substrate to form a molded glass paste on the glass substrate. Then, glass substrate to which glass paste was transferred in cell barrier shape was burned under the conditions of 585 $^{\circ}\text{C}$ peak temperature for 15 minutes of heating time to form cell barriers on PDP glass substrate.

[0037]

<<EXAMPLE 2>>

Cell barriers were formed on a glass substrate in the same manner as explained in the example on the manufacturing of shaping sheet by changing roll intaglio, electrolytic radiation curing resin composition and irradiation conditions in the manner as explained below.

[0038]

ROLL INTAGLIO

Cross sectional shape of plate surface: trapezoidal shape of which vertical cross section is separated [make reference to the Figure 10], horizontal cross section is of regular square.

Cell pitch P: 500 μ m

Cell groove width W : top bottom 450 μ m, lower bottom 100 μ m

Cell depth D : 150 μ m

[0039]

ELECTROLYTIC RADIATION CURING RESIN COMPOSITION

Pentaerithritol triacrylate	90 parts by weight
Urethane acrylate oligomer	10 parts by weight
2-hydroxy-2-methyl-1-phenyl propane-1-on (Dacocure 1173 made by Merc Co.)	0.7 parts by weight

[0040]

IRRADIATION CONDITIONS

High pressure mercury lamp with ozone , 160W/cm x2 lamps

[0041]

[EFFECTS OF THIS INVENTION]

As explained in details above, according to this invention's manufacturing method of cell barriers, it is possible to manufacture cell barriers with good precision and optional shape through one time patterning treatment easily, quickly and stably. Above all, shape of cell barriers can be other than rectangular parallelepiped , for instance, it can be of trapezoidal shape and the like to reduce cell barrier plane area at the front side plate of PDP, and allows highly colorful PDP easily as well.

[BRIEF DESCRIPTION OF THE FIGURES]

[FIGURES 1]

(a) illustrates a schematic drawing of coating process; and (b) illustrates a schematic drawing of first half of molding process; and (c) illustrates a schematic drawing of last half [of the processes].

[FIGURES 2]

The illustrate cross sections of roll intaglio, shaping sheet, and relationship of one example of given cell barrier shape.

[FIGURE 3]

It illustrates a schematic drawing that shows one example of manufacturing device that is used for manufacturing process of shaping sheet.

[FIGURE 4]

It illustrates a cross section of one example of shaping sheet and shape of corresponding cell barriers (trapezoidal shape of which cross section is separated).

[FIGURE 5]

It illustrates a schematic drawing of cross section of panel that is formed by sealing a back side plate having cell barriers and front side plate.

[FIGURE 6]

It illustrates a cross sectional view that shows one other example of shape of cell barriers (triangular shape of which cross section is separated) and corresponding shaping sheet.

[FIGURE 7]

It illustrated a cross sectional view that shows other example of shape of cell barriers (rectangular shape of which cross section is separated) and corresponding shaping sheet.

[FIGURE 8]

It illustrates a cross sectional view that shows another example of shape of cell barriers (convex curved line of which cross section is separated) and corresponding shaping sheet.

[FIGURES 9]

The illustrate cross sectional view and diagonal view that show one example of shape of plate intaglio part of roll intaglio.

[FIGURES 10]

They illustrate cross sectional view and diagonal view that show other example of shape of plate intaglio part of roll intaglio.

[FIGURE 11]

It illustrates a schematic drawing that shows other method of coating process.

[DESCRIPTION OF CODES]

1: cell barrier, 2: shaping sheet, 21: film backing, 22: electrolytic radiation curing resin layer, 23: sheet concave part, 3: electrolytic radiation curing resin, 4: roll intaglio, 41: plate intaglio part, 51: press roll, 52: release roll, 6: coating device, 7: electrolytic radiation ray irradiation device, 8: glass paste, 9: blade, 10: glass substrate

Figures 1 through 10

I: Figure

